AD-A166 726 AIRCREW TRAINING DEVICES: UTILITY AND UTILIZATION OF ADVANCED INSTRUCTION..(U) DAYTON UNIV OH RESEARCH INST D J POLZELLA MAR 86 AFHRL-TR-85-48 F33615-81-C-0005 1/1

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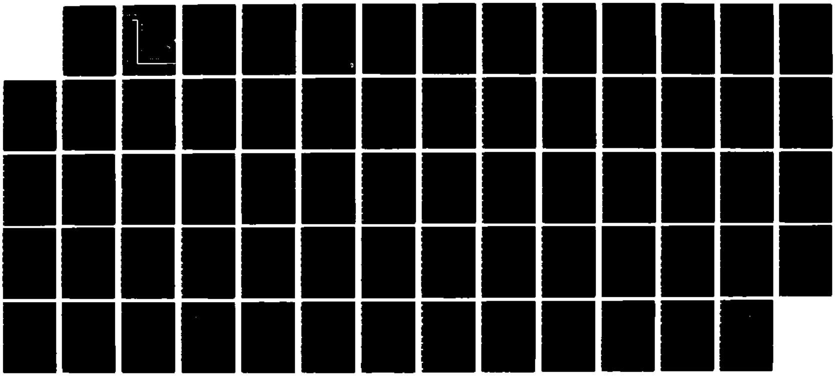

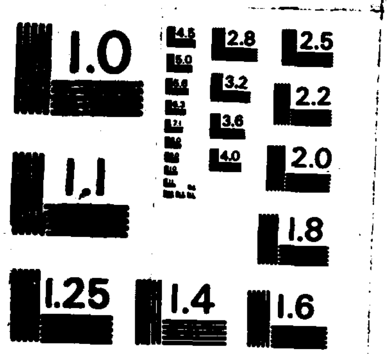
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AFHRL-TR-85-48

AIR FORCE

HUMAN RESOURCES

AD-A166 726

AIRCREW TRAINING DEVICES: UTILITY AND UTILIZATION OF ADVANCED INSTRUCTIONAL FEATURES (PHASE II - AIR TRAINING COMMAND, MILITARY AIRLIFT COMMAND, AND STRATEGIC AIR COMMAND)

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March 1986

Interim Report for Period May - September 1984

Approved for public release; distribution unlimited.

LABORATORY

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235-5601

NOTICE

This report has been reviewed and is approved for publication.

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

AD-A166726

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFHRL-TR-85-48
6a. NAME OF PERFORMING ORGANIZATION University of Dayton Research Institute 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Operations Training Division
6c. ADDRESS (City, State, and ZIP Code) 300 College Park Avenue Dayton, Ohio 45469	7b. ADDRESS (City, State, and ZIP Code) Air Force Human Resources Laboratory Williams Air Force Base, Arizona 85240-6457
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Air Force Human Resources Laboratory 8b. OFFICE SYMBOL (If applicable) HQ AFHRL	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-81-C-0005
8c. ADDRESS (City, State, and ZIP Code) Brooks Air Force Base, Texas 78235-5601	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 62205F; PROJECT NO. 1123; TASK NO. 03; WORK UNIT ACCESSION NO. 58

11. TITLE (Include Security Classification)
Aircrew Training Devices: Utility and Utilization of Advanced Instructional Features (Phase II - Air Training Command, Military Airlift Command, and Strategic Air Command)

12. PERSONAL AUTHOR(S)
Polzella, Donald J.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Interim	FROM May 84 TO Sep 84	March 1986	66

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	advanced instructional features; instructor/operator station
05	08		aircrew training devices; simulator training
05	09		flight simulator

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

An aircrew training device (ATD) is not merely a flight simulator. It is also equipped with sophisticated hardware and software capabilities, known as advanced instructional features (AIFs), that permit a simulator instructor to control, monitor, and fabricate simulator training missions. This report describes the second phase of a three-phase project designed to determine the utility and utilization of AIFs by means of a survey of simulator instructors from the USAF Major Commands. Phase I surveyed instructor pilots and weapons director instructors assigned to principal Tactical Air Command (TAC) ATD training sites. Phase II extended the survey to instructor pilots, instructor flight engineers, and instructor radar/navigators assigned to ATD training sites in the Air Training Command, Military Airlift Command, and Strategic Air Command. In general, Phase II ratings of AIF utility and utilization were considerably higher than those of Phase I. Yet, it was clear that most simulator instructors, regardless of Command, have not yet fully explored the existing instructional capabilities of ATDs. It was recommended that a formal intensive training program be established in order to teach simulator instructors how to use AIFs more effectively.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION
22a. NAME OF RESPONSIBLE INDIVIDUAL Nancy A. Perrigo, Chief, STINFO Office	22b. TELEPHONE (Include Area Code) (512) 536-3877; 22c. OFFICE SYMBOL AFHRL/TSR

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

SUMMARY

Aircrew training devices (ATDs) are often equipped with sophisticated hardware and software capabilities that permit a simulator instructor (SI) to control, monitor, record, and fabricate flight simulation training missions. These advanced instructional features (AIFs) reflect the primary role of the ATD as a flight trainer. The training value of an ATD is a function of the degree to which it simulates a particular aircraft and the way in which it is used as an instructional device. AIFs are costly to implement. In order to justify these costs, the following questions must be answered: How frequently are AIFs used? How easy are they to use? Are SI's adequately trained to use AIFs? Do AIFs have significant training value?

This report describes the second phase of a three-phase project designed to obtain answers to these questions by surveying SIs from the Air Force Major Commands (MAJCOMs). An on-site survey was administered to 273 SIs assigned to replacement training units (RTUs) and continuation training units (CTUs) at principal Air Training Command (ATC) (T-37, T-38), Military Airlift Command (MAC) (C-5A, C-141, C-130, CH-3, HH-53), and Strategic Air Command (SAC) (FB-111A) ATD sites. The survey requested background information along with five seven-point rating scales for evaluating each of 16 AIFs. Written comments concerning the 16 AIFs or the ATD were solicited. The most striking difference between the Phase I (TAC survey) and Phase II results was in the overall magnitude of the ratings. In comparison to the TAC SIs, the ATC, MAC, and SAC SIs used AIFs more often, found them easier to use, received more training in their use, and considered AIFs to be more important for training. The results suggested that TAC's SI training program is less extensive and less structured than those of the other MAJCOMs.

Features such as freeze, reset, motion, environmental, and crash/kill override were consistently rated high in utility and utilization, whereas features such as automated malfunction insertion, demonstration, record/playback, and hard copy were generally rated lower. The level of AIF use was affected somewhat by hardware and/or software unreliability, implementation time, functional limitations, and design deficiencies. The perceived training value of a feature was the most important determiner of its use.

PREFACE

This research was conducted to satisfy requirements of Air Force Human Resources Laboratory Technical Planning Objective 3, the thrust of which is aircrew training effectiveness. The general objective of this thrust is to identify and demonstrate cost-effective simulator training strategies and systems to develop and maintain the combat effectiveness of Air Force aircrew members. More specifically, the research was conducted under the Air Combat Training Research subthrust, the goal of which is to provide a technology base for training high level and quickly perishable skills in simulated combat environments. Work Unit 1123-02-34, Development and Evaluation of Advanced Instructional Features, addressed a portion of this subthrust. Capt L. Weikhorst was the project monitor and Dr. Donald J. Polzella, under contract to the University of Dayton Research Institute, was the principal investigator.

This effort was jointly coordinated by the Air Force Human Resources Laboratory, Operations Training Division, Williams AFB, Arizona; the Simulator System Program Office (SimSPO) of the Air Force Systems Command, Aeronautical Systems Division (AFSC/ASD), Wright-Patterson AFB, Ohio; Headquarters Air Training Command, Randolph AFB, Texas; Headquarters Military Airlift Command, Scott AFB, Illinois; and Headquarters Strategic Air Command, Offutt AFB, Nebraska. The author gratefully acknowledges the assistance of the following individuals:

Mr. H. Craig McLean (ASD/YWE)
Maj Buddy Simpson (ATC/XPTTP)
Capt Mike Nickell (3305 SCHS/IDG)
Maj Joe Burch (MAC/DOT)
Maj Ron Dukes (HQ MAC/DOTF)
Lt Col Roy Emerson (SAC/4235 STS)
Maj Baxter (443 MAW/DOT)
Russ Cheney (436 AMS/MAAD)
Dick Parsons (438 AMS/MAAD)
SMSGT Weaver (438 AMS/MAAD)
Maj Mike Sieverding (34 TATG/TTX)
Maj Paul Scoville (34 TATG)
Maj Tom Blystad (1550 ATTW)
Maj Sharkey (509 BMW/DOTD)
Lt Col Dale Wolfe (380 BMW/DOTD)
Mr. Richard Greatorex (AFHRL/OTU)

Special appreciation goes to Dr. David C. Hubbard (UDRI at AFHRL/OT) who conducted a portion of the survey.

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AIRCREW TRAINING DEVICES: UTILITY AND UTILIZATION OF ADVANCED INSTRUCTIONAL FEATURES (PHASE II - AIR TRAINING COMMAND, MILITARY AIRLIFT COMMAND, AND STRATEGIC AIR COMMAND)

I. INTRODUCTION

An aircrew training device (ATD) serves two functions. First, it is a ground-based substitute aircraft that permits student flight crews to fly in a safe and carefully controlled environment. More importantly, an ATD is, as its name implies, a teaching machine that is designed to facilitate the acquisition of flight crew skills. In order to fulfill this second function, an ATD is equipped with sophisticated hardware and software capabilities that permit a simulator instructor (SI) to control, monitor, and in some cases fabricate simulator training missions. These capabilities, which are listed in Table 1, are known as advanced instructional features (AIFs). The list was compiled from several sources, but it was drawn primarily from Semple, Cotton, and Sullivan's (1981) extensive report describing the AIF capabilities of various military and commercial devices.

Table 1. Advanced Instructional Features

BRIEFING FEATURES

Recorded Briefing permits SI to provide a student with information about the simulator and/or a structured training mission through audiovisual media presentation.[a]

Demonstration permits SI to demonstrate optimal flying performance by means of prerecorded standardized segments of simulated flight.[a]

Instructor Tutorial provides SI with self-paced programmed instruction in the capabilities and use of the flight simulator.[a]

Table 1. (Continued)

TRAINING MANAGEMENT FEATURES

Total System Freeze permits SI to suspend simulated flight by freezing all system parameters.[a]

Reset permits SI to return the simulated aircraft to a stored set of conditions and parameters.[a]

Crash and/or Kill Override permits SI to allow simulated flight to continue without interruption following a "crash" or "kill."[a]

Automated Adaptive Training is the computer-controlled variation in task difficulty, complexity, and/or sequence based on student's performance.[a]

Programmed Mission Scenarios are computer-controlled standardized training missions based on pre-programmed event sequences.[a]

VARIATION OF TASK DIFFICULTY FEATURES

Automated Malfunction Insertion permits SI to preprogram a sequence of aircraft component malfunctions and/or emergency conditions.[a]

Environmental permits SI to vary environmental conditions such as wind direction and velocity, turbulence, temperature, and visibility.[a]

Dynamics permits SI to vary flight dynamics characteristics such as stability, system gain, cross-coupling, etc.

Motion permits SI to provide a student with platform motion system cues such as roll, pitch, lateral, and vertical.[a]

Table 1. (Continued)

Flight System Freeze permits SI to simultaneously freeze flight control and propulsion systems, position, altitude, and heading.

Position Freeze permits SI to simultaneously freeze latitude and longitude.

Attitude Freeze permits SI to simultaneously freeze pitch, bank, and heading.

Parameter Freeze permits SI to freeze any one or a combination of flight parameters.[a]

INSTRUCTOR MONITOR AND FEEDBACK FEATURES

Closed Circuit TV permits SI to monitor student's behavior from the instructor console.

Repeaters/Annunciators provide SI with replicas or analog representations of flight instruments and controls at the instructor console.

Instructor Console Displays permit SI to view alphanumeric and/or graphic CRT displays of performance data at the instructor console.[a]

Automated Performance Alert provides SI with visual and auditory signals that indicate specific performance deficiencies.

STUDENT FEEDBACK FEATURES

Record/Playback permits SI to record and subsequently play back a segment of simulated flight.[a]

Table 1. (Concluded)

Automated Performance Feedback provides a student with visual and auditory signals (including verbal messages) that identify performance deficiencies.

Automated Voice Controller is the computer-based technology that simulates the role of a controller by combining speech generation, speech recognition, and situation awareness capabilities.

Hard Copy provides a record of alphanumeric and/or graphic performance data from the automated performance measurement system.[a]

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[a] These features were included in the Phase II questionnaire. (See Appendix.)

It appears that military ATDs are more often treated as substitute aircraft than as teaching machines. A recent report by the United States General Accounting Office (1983) concluded that the Armed Services have not sufficiently analyzed their training requirements for simulators. Nor have they adequately incorporated simulators into their training programs. In justifying the purchase of ATDs, the Services have focussed instead on "duplicating the actual weapon systems and their surroundings . . . with little reference to how the devices could meet training needs" (p. 4).

The present investigation was conducted at the request of the Simulator System Program Office (SimSPO) of the Air Force Systems Command, Aeronautical Systems Division (AFSC/ASD). The objectives of this investigation were:

1. To document and compare the utilization (i.e., frequency and ease of use) of AIFs.

2. To document and compare the utility (i.e., training value) of AIFs.

3. To compare the utility and utilization patterns of AIFs in replacement (e.g., basic, primary, lead-in, initial) and continuation (e.g., advanced, follow-on, refresher, operational) training units.

A broader objective of this investigation was to provide a database that could be helpful both in defining the requirements for ATD procurements and in developing future ATD training programs.

These objectives will be accomplished in several phases by means of a survey of simulator instructors (SIs) from the Air Force Major Commands (MAJCOMs). Phase I has already been completed, and the results of that survey are documented in an earlier report (Polzella, 1983).

The subjects in Phase I were 134 simulator-qualified instructor pilots (IPs) and weapons director instructors (WDIs) assigned to replacement training units (RTUs) and continuation training units (CTUs) at F-4E, F-4G, F-15, A-10, and E-3A Tactical Air Command (TAC) training sites. The results indicated that most TAC SIs received little training in the use of AIFs and that most features were not used very often. Several factors appeared to have contributed to the low usages: (a) hardware and/or software unreliability, (b) time-consuming implementation, (c) functional limitations, and (d) design deficiencies. The results of a multiple regression analysis indicated that ease of use and training value accounted for most of the variability in the frequency-of-use ratings.

The utility and utilization of particular AIFs differed both as a function of ATD and of training unit. For example, features such as freeze and reset were generally used more often during RTU missions, whereas programmed mission scenarios were generally used more often during CTU missions. These differences appeared to reflect differences in the respective training missions. Thus, RTU missions characteristically include a series of discrete procedural exercises, whereas lengthier scenarios are common during CTU missions.

Based on the results of Phase I, it was recommended that future procurement of AIFs be preceded by a detailed front end analysis that clearly relates AIF capability to training needs as well as to any major constraints in the operational environment. During procurement, AIF specifications should be prepared so as to meet user needs and ensure equipment reliability. After operational deployment, the user should provide adequate instructor/operator training in AIF use.

Phase II, which is described in this report, extended the survey to SIs from Air Training Command (ATC), Military Airlift Command (MAC), and Strategic Air Command (SAC).

II. METHOD

Subjects

The subjects in Phase II were 273 instructor pilots (IPs), instructor flight engineers (IFEs), and instructor radar navigators (IRNs) assigned to RTUs or CTUs at the following training sites: Williams AFB (T-50/T-37 and T-51/T-38; RTU), Altus AFB (C-5A and C-141; RTU), Dover AFB (C-5A; CTU), McGuire AFB (C-141; CTU), Little Rock AFB (C-130; RTU, CTU), Kirtland AFB (CH-3 and HH-53; RTU, CTU), Plattsburgh AFB (FB-111A; RTU, CTU), and Pease

AFB (FB-111A; CTU). The distribution of SIs among the various ATDs and training units is shown in Table 2. The SIs' hours of experience as instructors are summarized in Table 3.

Table 2. The Number of SIs Surveyed in Phase II

Command	ATD	Type of SI	Training unit RTU	Training unit CTU
ATC	T-50	IP	29	
	T-51	IP	21	
MAC	C-5A	IP	16	11
		IFE	13	6
	C-141	IP	26	6
		IFE	14	7
	C-130	IP	13	7
		IFE	8	6
	CH-3	IP	3	4
		IFE	3	1
	HH-53	IP	5	6
		IFE	0	6
SAC	FB-111A	IP	6	24
		IRN	11	21
			168	105

Table 3. Simulator Instructor's Mean (and Standard Deviation) Number of Instructor Hours

Command	ATD	RTU	CTU
ATC	T-50	173.6 (169.5)	
	T-51	129.4 (96.8)	
MAC	C-5A	511.1 (452.1)	454.1 (386.8)
	C-141	582.5 (531.4)	1174.6 (1504.1)
	C-130	126.8 (80.4)	419.8 (189.9)
	CH-3	169.2 (94.4)	263.4 (132.7)
	HH-53	139.2 (149.8)	482.5 (452.1)
SAC	FB-111A	797.1 (693.3)	353.0 (818.4)

Questionnaire

The questionnaire that was used to survey the instructors is shown in the Appendix. It is similar to that used in Phase I. (See Polzella, 1983, Appendix A.) The questionnaire requested background information (i.e., flying and simulator experience), a brief description of a typical training mission, and included a list of 16 AIFs (drawn from the list in Table 1) and their definitions and five questions concerning the utility and utilization of each feature:

1. How often have you used it?
2. How easy is it to use?
3. How much training did you receive in its use?
4. What is its training value?
5. What is its potential training value?

For the fifth question, SIs were asked to assume that they had no prior knowledge of the features and to base their responses on the feature definitions alone. This question was included in order to achieve a common basis for comparison among all SIs. This was not otherwise possible because the various ATDs were not similarly equipped.

Responses to each question were indicated by checking the appropriate interval along a seven-point, successive-category rating scale. (The scales for questions 2 and 4 included a zero-point interval for indicating "no basis for judgment.") The intervals of each scale were labeled with descriptive adjectives in order to facilitate responding and to help interpret the ratings. Additional space was provided for comments.

Procedure

The questionnaire was administered on-site to various sized (N = 2 to 25) groups of SIs. The SIs were briefed on the purpose of the investigation and copies of the questionnaire were distributed and thoroughly reviewed prior to being filled out. The questionnaire could be completed in approximately 30 minutes.

III. RESULTS

Table 4 lists the 16 AIFs that were included in the questionnaire along with their definitions. The table also indicates a mnemonic code for each feature, which will be used in subsequent tables. The AIF capabilities of the various ATDs are shown in Table 5.

Table 4. Advanced Instructional Features Included in the Phase II Questionnaire

Code	Feature
IPT	Instructor Pilot Tutorial - provides the IP with self-paced programmed instruction in the capabilities and use of the flight simulator.
R	Reset - permits instructor to "return" the simulated aircraft to a stored set of conditions and parameters.
TSF	Total System Freeze - permits instructor to interrupt and suspend simulated flight by freezing all system parameters.
RB	Recorded Briefing - permits instructor to provide student with information about a structured training session through audio/visual media presentation.
D	Demonstration - permits instructor to demonstrate aircraft maneuver(s) by prerecording and subsequently playing back a standardized segment of simulated flight.

Table 4. (Concluded)

Code	Feature
RP	Record/Playback - permits instructor to record and subsequently playback all events that occurred during a segment of simulated flight.
E	Environmental - permits instructor to vary environmental conditions such as wind direction and velocity, turbulence, temperature, visibility, etc.
AMI	Automated Malfunction Insertion - permits instructor to preprogram a sequence of aircraft component malfunctions and/or emergency conditions.
PF	Partial Freeze - permits instructor to freeze various flight parameters or parameter combinations such as altitude, heading, position, attitude, flight system, etc.
CKO	Crash and/or Kill Override - permits instructor to allow simulated flight to continue without interruption following a "crash" or "kill."
M	Motion - permits instructor to vary platform motion system cues such as roll, pitch, lateral, vertical, etc.
HC	Hard Copy - provides a record of alphanumeric and/or graphic performance data from the automated performance measurement system for debriefing purposes.
AAT	Automated Adaptive Training - computer-controlled variations in task difficulty, complexity, and sequence based on pilot's performance.
PMS	Programmed Mission Scenarios - computer-controlled standardized training sessions based on pre-programmed event sequences.
PRM	Procedures Monitoring - permits instructor to monitor discrete actions performed by the student in accordance with a procedurally defined checklist.
PAM	Parameters Monitoring - permits instructor to monitor various instrument readings, control settings, aircraft states, or navigational profiles.

Table 5. AIF Capability of Each ATD

Feature	T-50	T-51	C-5A	C-141	C-130	CH-3	HH-53	FB-111A
IPT								
R	X	X	X	X	X	X	X	X
TSF	X	X	X	X	X	X	X	X
RB								
D					X	X	X	X
RP	X	X			X	X	X	X
E	X	X	X	X	X	X	X	X
AMI	X	X			X			
PF	X	X	X	X	X	X	X	X
CKO	X	X	X	X	X	X	X	X
M	X	X	X	X	X	X	X	X
HC					X			X
AAT								
PMS					X			X
PRM					X			X
PAM					X	X	X	X

The raw data included the SIs' descriptions of a typical training mission and their ratings on each question coded as 0 (no basis for judgment) to 7 (maximum rating). The ratings were classified by ATD (T-50, T-51, C-5A, C-141, C-130, CH-3, HH-53, FB-111A), training unit (RTU, CTU), question (1 through 5) and AIF (1 through 16). The resulting data matrix was unbalanced due to the differences in the number of SIs and in the AIF capabilities of the various ATDs (see Tables 2 and 5). This necessitated analyzing the data from each ATD separately, with two exceptions. The C-5A and C-141 data and the CH-3 and HH-53 data were pooled, respectively, before they were analyzed. The pooling of these data was not inappropriate since the respective training missions were highly similar. Moreover, the resulting increase in sample size was statistically desirable, especially in the case of the CH-3 and HH-53 data.

T-50/T-51 Simulator Training Missions

The T-50 (T-37) and T-51 (T-38) training missions are similar, each lasting approximately 1-1/2 hours. In addition, there are briefing and debriefing periods lasting 20 to 30 minutes each. Although missions may vary from partial task to full mission profile, most missions include takeoffs, instrument and emergency procedures, turns, climbs, descents, course intercepts, penetrations, and multiple approaches. In addition, the T-51 mission emphasizes certain advanced skills that reflect the particular characteristics of the T-38 aircraft, such as steep turns, unusual attitudes, and vertical s maneuvers.

Frequency of AIF Use

The frequency-of-use ratings are summarized in Table 6. Here and in subsequent tables, the features are listed in decreasing order according to the mean ratings. The individual ratings ranged from 1 (never use) to 7 (use most often). The frequency of AIF use appears to be fairly high, with most of the means ranging from 3.5 to 6.5 (i.e., moderately often to very frequently).

Table 6. T-50, T-51 Instrument Flight Simulators: Mean Ratings (and Standard Deviations) of the Frequency of AIF Use

Feature	T-50	T-51	Combined
M	6.6 (1.2)	6.2 (1.9)	6.4
TSF	5.7 (1.4)	6.1 (0.9)	5.9
R	5.6 (1.3)	6.2 (0.8)	5.9
E	5.5 (1.3)	6.3 (0.7)	5.8
**PF	3.9 (1.7)	5.3 (1.4)	4.5
CKO	3.6 (1.4)	3.8 (1.4)	3.7
RP	3.4 (1.3)	3.9 (1.3)	3.6
AMI	3.7 (2.2)	3.1 (1.9)	3.5
*Combined	4.8	5.1	4.9

*$p < .05$.
**$p < .01$.

A two-factor (ATD x AIF) repeated measures analysis of covariance (covariate = number of instructor-hours) was used to analyze the data. The analysis indicated that the T-51 SIs overall mean rating (4.9) was significantly higher than that of the T-50 SIs (4.5), $F(1,47) = 5.26$, $p < .05$. There was also a significant main effect of AIF, $F(7,336) = 42.92$, $p < .001$, and a significant AIF by ATD interaction, $F(7,336) = 3.17$, $p < .01$.

The significant main effect of AIF implies that there are significant differences among the overall ratings of each feature. The Tukey honestly significant difference (HSD) test (Keppel, 1973, p. 138) was used to determine these differences. The results of the test are shown in Table 6 by the placement of brackets around those means that did not differ significantly ($p > .01$). Thus, motion, total system freeze, reset, and environmental received the highest ratings, whereas the remaining features received significantly lower ratings.

The significant interaction implies that the pattern of ratings was different for the two groups of SIs. The Dunn test (Keppel, 1973, pp. 147-149) was used to determine the locus of this interaction by making post hoc comparisons between the various T-50/T-51 adjusted mean pairs. The significant comparisons are indicated in the table by asterisks. Only one significant difference was obtained, that for partial freeze, which was rated significantly higher by T-51 SIs ($p < .01$).

Ease of AIF Use

The ease-of-use ratings are summarized in Table 7. The individual ratings ranged from 1 (most difficult) to 7 (easiest). Ease of use appears to be very high, with most of the means ranging from 4.5 to 6.5 (i.e., easy to very easy). Unlike the frequency of use ratings, the means in Table 7 were based on a variable frequency that reflected the number of SIs who actually used each feature. Consequently, the nonparametric Wilcoxen test was used to compare the T-50 and T-51 ratings, overall, and t-tests were used to make separate T-50/T-51 comparisons for each feature. The significant differences are indicated in Table 7 by asterisks. Thus, the T-51 mean rating of partial freeze was significantly higher than the corresponding T-50 mean rating, $t(47) = -2.84$, $p < .01$.

Training in AIF Use

The amount of training received in AIF use is summarized in Table 8. The individual ratings ranged from 1 (no training received) to 7 (greatest amount received). The mean ratings were fairly high, although not as high as the frequency-of-use and ease-of-use ratings. Most ranged from 3.5 to 5.5 (i.e., moderate to considerable).

A two-factor (ATD x AIF) repeated measures analysis of covariance (covariate = number of instructor-hours) was used to analyze the data. The analysis revealed significant main effects of ATD, $F(1,47) = 5.84$, $p < .025$, and of AIF, $F(7,336) = 11.86$, $p < .001$. The interaction was not significant, $F(7,336) = 1.71$, $p > .05$. It appears that T-51 SIs received more training in the use of AIFs than did T-50 SIs; however, the pattern of use for the two groups was statistically equivalent. The Tukey HSD test was used to determine the significant differences among the combined

Table 7. T-50, T-51 Instrument Flight Simulators: Mean Ratings (and Standard Deviations) of the Ease of AIF Use

Feature	T-50	T-51	Combined
TSF	6.7 (0.6)	6.8 (0.4)	6.7
M	6.4 (0.6)	6.4 (0.7)	6.4
R	5.9 (0.8)	6.0 (0.7)	6.0
*PF	5.5 (1.2)	6.4 (0.7)	5.9
CKO	5.7 (1.2)	5.8 (1.3)	5.7
E	5.2 (1.3)	5.1 (1.3)	5.2
AMI	5.2 (1.7)	5.3 (1.0)	5.2
RP	4.9 (1.0)	5.4 (1.1)	5.1
Unweighted Means	5.7	5.9	5.8

*$p < .01$.

ratings of each AIF, and the results of that test are shown in Table 8 by the placement of brackets around the means that did not differ significantly ($p > .01$). The results closely parallel those shown in Table 6. Thus, the features receiving the greatest amount of training were also those features that were most frequently used.

Table 8. T-50, T-51 Instrument Flight Simulators: Mean Ratings (and Standard Deviations) of the Amount of Training Received in AIF Use

Feature	T-50	T-51	Combined
TSF	4.6 (1.7)	5.6 (1.3)	5.0
M	4.6 (1.6)	4.8 (2.0)	4.7
R	4.2 (1.1)	5.1 (0.9)	4.6
E	4.2 (1.6)	4.7 (1.1)	4.4
RP	3.5 (1.2)	4.6 (0.9)	4.0
PF	3.3 (1.3)	4.5 (1.2)	3.8
CKO	3.7 (1.3)	4.0 (1.3)	3.8
AMI	3.3 (1.7)	3.5 (1.6)	3.4
Combined**	3.9	4.6	4.2

**$p < .025$.

Training Value of AIFs

The training value ratings are summarized in Table 9. The individual ratings ranged from 1 (no training value) to 7 (greatest training value). The ratings were extremely high, with most of the means in the 4.5 to 6.5 range (i.e., considerable to great). Like the ease-of-use ratings, the means in Table 9 were based on a variable frequency that reflected the number of SIs who actually used each feature. Consequently, the nonparametric Wilcoxen test was used to compare the T-50 and T-51 ratings, overall, and t-tests were used to make separate T-50/T-51 comparisons for each feature. There were no significant comparisons ($p > .05$).

Table 9. T-50, T-51 Instrument Flight Simulators: Mean Ratings (and Standard Deviations) of the Training Value of AIFs

Feature	T-50	T-51	Combined
E	6.2 (0.9)	6.2 (1.0)	6.2
M	6.1 (1.0)	6.0 (1.0)	6.1
R	5.9 (0.9)	6.3 (0.8)	6.1
TSF	6.0 (0.8)	6.1 (1.0)	6.0
RP	4.9 (1.0)	5.5 (1.3)	5.1
PF	4.8 (1.4)	5.3 (1.1)	5.0
AMI	5.0 (1.6)	4.1 (2.1)	4.6
CKO	4.4 (1.5)	4.4 (1.5)	4.4
Unweighted Means	5.4	5.5	5.4

Potential Training Value of AIFs

The potential training value ratings are summarized in Table 10. The individual ratings ranged from 1 (no potential value) to 7 (greatest potential value). Like the training value ratings, the potential training value ratings were very high, with most means ranging from 4.5 to 6.5 (i.e., considerable to great).

A two-factor (ATD x AIF) repeated measures analysis of covariance (covariate = number of instructor-hours) was used to analyze the data. The analysis revealed a significant main effect of AIF, $F(15,720) = 16.56$, $p < .001$, and a significant ATD by AIF interaction, $F(15,720) = 1.84$, $p < .05$. The main effect of ATD was not significant, $F < 1.00$.

The Tukey HSD test was used to determine the significant differences among the combined ratings of each AIF, and the results of that test are shown in Table 10 by the placement of brackets around the means that did not differ significantly ($p > .01$). Once again the results closely

Table 10. T-50, T-51 Instrument Flight Simulators: Mean Ratings (and Standard Deviations) of the Potential Training Value of AIFs

Feature	T-50	T-51	Combined
E	6.3 (1.0)	6.3 (1.0)	6.3
R	6.3 (0.7)	6.2 (0.7)	6.3
M	6.3 (1.1)	5.9 (1.1)	6.2
TSF	6.1 (1.1)	6.2 (0.8)	6.1
RP	5.2 (1.3)	5.9 (1.2)	5.5
PF	5.0 (1.7)	5.5 (0.8)	5.2
AMI	5.4 (1.5)	4.7 (1.8)	5.1
PAM	4.6 (2.2)	5.5 (1.4)	5.0
D	4.6 (1.6)	5.5 (1.2)	4.9
CKO	4.8 (1.4)	4.9 (1.1)	4.8
RB	4.7 (2.0)	5.0 (1.5)	4.8
PMS	4.8 (1.8)	4.3 (1.0)	4.6
PRM	4.3 (2.0)	5.0 (1.5)	4.6
HC	4.5 (2.0)	4.5 (1.3)	4.5
AAT	4.1 (2.0)	4.0 (1.1)	4.1
IPT	4.0 (1.6)	4.4 (1.5)	4.1
Combined	5.1	5.2	5.1

parallel those shown in Table 6. Thus, the features rated highest in potential training value were also those features that were most frequently used.

Despite the indication of a significant interaction, its locus was not revealed by the Dunn test, which was used to make post hoc comparisons between the various T-50/T-51 adjusted mean pairs. The interaction was, therefore, considered to be of minimal importance.

Interrelations Among the Variables

Table 11 shows the intercorrelations among the ratings of each feature on each of the five questions. All the coefficients are positive and significant, $p < .001$. Therefore, a feature's rating on any question can be predicted with greater than chance accuracy given its rating on any other question. For example, it can be generally stated that the more frequently a feature was used, the easier it was to use, the more training was received in its use, and the greater its training and potential training value.

Table 12 summarizes the results of a stepwise multiple linear regression analysis in which the frequency of AIF use was predicted from a linear combination of the remaining variables. The table indicates that, together, the predictor variables accounted for 53 percent of the variance in the frequency-of-use ratings, the most important predictor being training value followed, in order, by ease of use, potential training value, and training received.

Military Airlift Command

The MAC ATDs that were surveyed included the C-5A, C-141, C-130, CH-3, and HH-53. The same analyses that were performed on the ATC data were used to analyze the MAC data. As discussed previously, C-5A and C-141 and the CH-3 and HH-53 data were pooled, respectively, before they were analyzed.

C-5A/C-141 Flight Simulators

Training mission. The C-5A/C-141 RTU and CTU training missions are similar, each lasting approximately 4 hours. Usually, students will "swap seats" after 2 hours. In addition, there are 2-hour briefing and 1-hour debriefing sessions. Both missions consist of a wide variety of normal and emergency procedures that stress crew coordination. Partial or total real-time scenarios typically provide the training context, especially for the CTU mission.

Frequency of AIF use. The frequency-of-use ratings are summarized in Table 13. Like the ATC ratings, the C-5A/C-141 ratings were fairly high, with most of the means in the 3.5 to 5.5 range (i.e., moderately often to frequently). A two-factor (training unit x AIF) repeated measures analysis of covariance (covariate = number of instructor-hours) revealed a significant main effect of AIF, $F(5,465) = 23.53$, $p < .001$, and a significant AIF by training unit interaction, $F(5,465) = 4.86$, $p < .001$. The main effect of training unit was not significant, $F(1,92) < 1.00$.

Table 11. T-50, T-51 Instrument Flight Simulators: Matrix of Intercorrelations Among Frequency of Use, Ease of Use, Training Received, Training Value, and Potential Training Value

	FREQUSE	EASEUSE	TRECD	TVALUE	PTVALUE
FREQUSE	1.00				
EASEUSE	.51	1.00			
TRECD	.49	.38	1.00		
TVALUE	.63	.43	.42	1.00	
PTVALUE	.60	.35	.38	.72	1.00

Note All correlations are significant, $p < .001$.

Table 12. T-50, T-51 Instrument Flight Simulators: Multiple Linear Regression of Frequency of AIF Use on Ease of Use, Training Received, Training Value, and Potential Training Value

Dependent Variable:	Frequency of AIF Use
Multiple R:	.73
Multiple R-Square:	.53
Standard Error of Estimate:	1.29

Analysis of Variance:

	Sum of Squares	DF	Mean Square	F	p
Regression	835.3630	4	208.8408	125.03	< .001
Residual	741.6020	444	1.6703		

Summary of Stepwise Regression:

Step No.	Variable	Multiple R	Multiple RSQ	Increase in RSQ	F-to-Enter
1	TVALUE	.63	.39	.39	288.02
2	EASEUSE	.68	.46	.07	57.33
3	PTVALUE	.71	.50	.04	35.97
4	TRECD	.73	.53	.03	26.72

Table 13. C/5A-C-141 Flight Simulators: Mean Ratings (and Standard Deviations) of the Frequency of AIF Use

Feature	RTU	CTU	Combined
M	5.1 (2.0)	5.7 (2.1)	5.3
CKO*	5.5 (2.1)	4.4 (2.2)	5.2
E	5.1 (1.6)	5.3 (1.7)	5.2
R	4.5 (1.9)	4.3 (1.9)	4.4
PF**	4.3 (1.8)	3.1 (2.1)	3.9
TSF	3.1 (1.4)	3.4 (1.5)	3.2
Combined	4.6	4.4	4.5

*$p < .05$.
**$p < .01$.

A Tukey HSD test revealed that the highest ratings were assigned to motion, crash/kill override, and environmental. A Dunn test indicated that the RTU SIs assigned significantly higher frequency-of-use ratings to crash/kill override and to partial freeze than did the CTU SIs.

Ease of AIF use. The ease-of-use ratings are summarized in Table 14. Ease of use appeared to be extremely high, with most of the means ranging from 5.5 to 6.5 (i.e., very easy). There was no overall difference between the RTU and CTU ratings, $T = 7$, $p > .05$, nor were there any significant RTU/CTU differences for particular features.

Training in AIF Use. The amount of training received in AIF use is summarized in Table 15. Most of the means range from 3.5 to 4.0 (i.e., moderate) and are somewhat lower than the corresponding ATC means. The analysis of covariance revealed a significant effect of AIF, $F(5,465) = 3.49$, $p < .01$. SIs apparently received most training in the use of environmental, reset, and motion. Interestingly, these AIFs were rated lowest in ease of use. Neither the main effect of training unit, $F < 1.00$, nor the AIF by training unit interaction, $F(4,465) = 1.27$, $p > .05$ was significant.

Table 14. C-5A/C-141 Flight Simulators: Mean Ratings (and Standard Deviations) of the Ease of AIF Use

Feature	RTU	CTU	Combined
CKO	6.3 (0.9)	6.1 (1.0)	6.2
TSF	6.0 (0.9)	5.9 (0.9)	6.0
PF	5.9 (0.9)	5.7 (0.9)	5.8
M	5.7 (1.0)	5.9 (1.3)	5.8
R	5.4 (0.8)	5.5 (1.0)	5.5
E	5.3 (0.8)	5.2 (0.8)	5.3
Unweighted Means	5.8	5.7	5.8

Table 15. C-5A/C-141 Flight Simulators: Mean Ratings (and Standard Deviations) of the Amount of Training Received in AIF Use

Feature	RTU	CTU	Combined
E	4.2 (1.3)	3.7 (1.6)	4.1
R	3.7 (1.7)	3.6 (1.8)	3.7
M	3.6 (1.5)	3.8 (1.6)	3.7
TSF	3.7 (1.5)	3.6 (1.5)	3.6
CKO	3.6 (1.6)	3.6 (1.5)	3.6
PF	3.5 (1.5)	3.2 (1.9)	3.4
Combined	3.7	3.6	3.7

Training value of AIFs. The training value ratings are summarized in Table 16. The ratings were quite high, with most of the means in the 4.5 to 5.5 range (i.e., *considerable*). While there was no overall difference between the RTU and CTU ratings, $T = 2.5$, $p > .05$, the CTU SIs assigned significantly higher ratings to motion and to total system freeze than did the RTU SIs, $t(91) = -2.38$, $p < .05$, and $t(93) = -2.51$, $p < .05$, respectively.

Table 16. C-5A/C-141 Flight Simulators: Mean Ratings (and Standard Deviations) of the Training Value of AIFs

Feature	RTU	CTU	Combined
M*	5.4 (1.3)	6.1 (1.1)	5.6
R	5.2 (1.2)	5.5 (1.1)	5.3
E	5.2 (1.3)	5.3 (1.3)	5.2
PF	5.2 (1.4)	5.0 (1.0)	5.1
TSF*	4.4 (1.4)	5.2 (1.3)	4.7
CKO	4.6 (1.7)	4.8 (1.7)	4.7
Unweighted Means	5.0	5.3	5.1

*$p < .05$.

C-130 Flight Simulator

Training mission. The C-130 RTU and CTU missions are similar to those of the C-5A/C-141. Each training session consists of a 1- to 2-hour prebriefing, a 4-hour mission, and a 1-hour debriefing. Both the RTU and CTU student crews receive extensive practice in normal and emergency procedures during takeoffs, in-flight malfunctions, and full-stop landings. CTU cross-country missions are typically flown under a variety of passenger/cargo configurations and weather conditions.

Frequency of AIF Use. The C-130 frequency-of-use ratings are summarized in Table 17. Although the overall mean rating of 3.9 (i.e., *moderately often*) was somewhat lower than that of the other ATDs, the

Table 17. C-130 Flight Simulator: Mean Ratings (and Standard Deviations) of the Frequency of AIF Use

Feature	RTU	CTU	Combined
M	6.6 (1.4)	7.0 (0.0)	6.7
E	5.4 (1.0)	6.4 (0.9)	5.8
R	5.7 (1.0)	5.5 (1.3)	5.6
CKO	5.1 (1.4)	5.0 (1.4)	5.1
TSF	4.7 (1.3)	4.6 (1.6)	4.6
PF	4.7 (1.5)	4.1 (1.4)	4.4
PAM	4.2 (1.7)	3.2 (1.9)	3.8
AMI**	3.9 (2.8)	1.5 (0.5)	3.0
PRM	3.0 (1.9)	2.8 (1.4)	2.9
HC	2.6 (1.2)	2.1 (0.8)	2.4
D	1.6 (1.0)	2.4 (1.6)	1.9
RP	1.9 (1.2)	2.0 (0.7)	1.9
PMS	2.0 (1.9)	1.5 (0.7)	1.8
Combined	3.9	3.7	3.9

$^{**}p < .01$.

highest rated features were nevertheless used very frequently. The analysis of covariance revealed a significant effect of AIF, $F(12,384) = 53.23$, $p < .001$, and a significant AIF by training unit interaction, $F(12,384) = 3.25$, $p < .001$. The difference between the overall RTU and CTU ratings was not significant however, $F < 1.00$.

The Tukey HSD test indicated that the highest ratings were assigned to motion, environmental, reset, and crash/kill override. These same features received consistently high ratings at the other sites as well. Procedures monitoring, hard copy, demonstration, record/playback, and programmed mission scenarios received the lowest ratings. The Dunn test revealed only one significant RTU/CTU comparison, that for automated malfunction insertion; it was used significantly more often by RTU SIs.

Ease of AIF Use. The ease-of-use ratings are summarized in Table 18. As was the case for all the ATDs surveyed, ease of use was quite high, with most of the C-130 means in the 4.5 to 6.0 range (i.e., easy to very easy). There was no overall difference between the RTU and CTU ratings, $T = 22.5$, $p > .05$; however, parameters monitoring was rated significantly easier to use by RTU than by CTU SIs, $t(32) = 2.72$, $p < .05$.

Training in AIF use. The amount of training received in AIF use is summarized in Table 19. Most of the means are in the moderate range. The analysis of covariance revealed a significant effect of AIF, $F(12,384) = 15.03$, $p < .001$, but neither the main effect of training unit nor the interaction was significant, $Fs < 1.00$. The results of the Tukey HSD test closely paralleled the results obtained from the frequency-of-use data. Those features that received the most and least amounts of training were used most and least often, respectively.

Training value of AIFs. The training value ratings are summarized in Table 20. The ratings were fairly high, with most of the means in the 4.0 to 6.0 range (i.e., moderate to great). The lowest ratings were generally assigned to the least frequently used features. The overall difference between the RTU and CTU ratings was not significant, $T = 22$, $p > .05$; however, automated malfunction insertion was rated higher by RTU than by CTU SIs, $t(24) = 3.13$, $p < .01$.

CH-3/HH-53 Flight Simulators

Training mission. The CH-3/HH-53 training mission lasts approximately 3 to 4 hours and includes two separate 1-1/2- to 2-hour missions; in addition there are prebriefings and debriefings. Due to the lack of a visual system, instrument flying is emphasized. Student crews practice takeoffs, holding patterns, fix-to-fix, blind landings, and emergency procedures. Malfunctions, which are inserted manually and with great regularity, typically require the crew to respond in a highly coordinated manner. Although the RTU and CTU missions are similar, the CTU mission tends to be somewhat more demanding.

Frequency of AIF use. The CH-3/HH-53 frequency-of-use ratings are summarized in Table 21. The frequency of AIF use appears to be fairly high, with most of the means in the 4.5 to 6.0 range (i.e., frequently to very frequently). Only demonstration was rarely used. The analysis of covariance revealed that, overall, the CTU SIs reported greater AIF use than did the RTU SIs, $F(1,25) = 9.88$, $p < .01$. There was also a significant main effect of AIF, $F(8,208) = 30.76$, $p < .001$. The AIF by training unit interaction was not significant, $F(8,208) = 1.29$, $p > .05$. The Tukey HSD test revealed that, except for record/playback and demonstration, the frequency of AIF use was uniformly high.

Table 18. C-130 Flight Simulator: Mean Ratings (and Standard Deviations) of the Ease of AIF Use

Feature	RTU	CTU	Combined
TSF	6.2 (0.9)	6.3 (0.9)	6.2
CKO	6.0 (1.0)	6.3 (0.9)	6.1
M	5.8 (1.1)	6.2 (1.0)	5.9
PF	5.9 (1.2)	5.8 (1.1)	5.9
R	5.5 (1.0)	5.9 (0.8)	5.6
E	5.4 (1.2)	5.9 (1.0)	5.6
AMI	5.0 (1.9)	5.8 (0.9)	5.3
PMS	4.7 (1.1)	5.2 (1.5)	5.0
PAM*	5.3 (1.3)	3.8 (1.7)	4.7
HC	4.7 (1.4)	4.8 (1.6)	4.7
PRM	4.8 (1.3)	4.4 (1.4)	4.7
D	4.1 (1.1)	4.5 (1.1)	4.3
RP	4.1 (0.8)	4.3 (1.6)	4.2
Unweighted Means	5.2	5.3	5.2

*$p < .05$.

Table 19. C-130 Flight Simulator: Mean Ratings (and Standard Deviations) of the Amount of Training Received in AIF Use

Feature	RTU	CTU	Combined
M	5.0 (1.6)	5.5 (1.1)	5.2
E	4.9 (1.4)	4.8 (0.6)	4.9
CKO	4.7 (1.5)	4.8 (1.0)	4.7
R	4.6 (1.2)	4.8 (0.8)	4.6
TSF	4.6 (1.3)	4.8 (1.0)	4.6
PF	4.4 (1.4)	4.2 (0.9)	4.3
PAM	4.3 (1.2)	4.1 (1.0)	4.2
PRM	3.6 (1.5)	4.2 (1.0)	3.8
AMI	3.8 (2.1)	3.5 (1.5)	3.6
HC	3.4 (1.7)	3.8 (1.0)	3.5
PMS	2.9 (1.8)	3.5 (1.4)	3.1
RP	2.8 (1.4)	3.5 (1.2)	3.1
D	2.4 (1.1)	3.2 (1.2)	2.7
Combined	3.9	4.2	4.0

Table 20. C-130 Flight Simulator: Mean Ratings (and Standard Deviations) of the Training Value of AIFs

Feature	RTU	CTU	Combined
M	6.2 (1.3)	6.4 (0.7)	6.2
R	5.5 (1.0)	6.0 (1.2)	5.7
TSF	5.6 (0.9)	5.6 (1.5)	5.6
E	5.4 (1.4)	5.9 (1.0)	5.6
CKO	5.3 (1.1)	5.1 (1.1)	5.2
PF	5.2 (1.2)	4.8 (1.6)	5.1
PAM	4.7 (1.5)	4.1 (1.9)	4.4
AMI**	5.2 (1.8)	3.1 (1.6)	4.3
PMS	4.8 (1.6)	3.7 (1.8)	4.3
PRM	4.2 (1.7)	3.7 (1.8)	4.0
D	3.4 (1.5)	3.4 (1.8)	3.4
RP	3.0 (1.4)	3.4 (1.4)	3.2
HC	3.1 (1.3)	3.2 (1.6)	3.2
Unweighted Means	4.7	4.5	4.6

$^{**}p < .01$.

Table 21. CH-3, HH-53 Flight Simulators: Mean Ratings (and Standard Deviations) of the Frequency of AIF use

Feature	RTU	CTU	Combined
M	5.3 (2.4)	6.6 (0.9)	6.1
E	4.8 (1.2)	6.2 (1.0)	5.7
PAM	4.9 (2.2)	6.0 (1.0)	5.6
TSF	4.5 (1.0)	6.1 (0.7)	5.5
CKO	5.1 (2.0)	5.4 (1.6)	5.3
R	4.3 (1.3)	5.5 (1.1)	5.1
PF	4.3 (1.7)	4.7 (1.9)	4.6
RP	2.2 (1.2)	3.8 (1.4)	3.2
D	1.5 (1.5)	1.6 (1.3)	1.6
Combined**	4.1	5.1	4.7

**$p < .01$.

Ease of AIF use. The ease-of-use ratings are summarized in Table 22. Except for demonstration, all the features received high mean ratings. There was no overall difference between the RTU and CTU ratings, $T = 18.5$, $p > .05$, nor were there any significant differences for particular features.

Table 22. CH-3, HH-53, Flight Simulators: Mean Ratings (and Standard Deviations) of the Ease of AIF Use

Feature	RTU	CTU	Combined
TSF	6.6 (0.5)	6.4 (0.6)	6.5
M	6.3 (0.9)	6.2 (1.0)	6.3
CKO	6.5 (0.7)	6.1 (0.8)	6.2
PAM	5.8 (1.4)	5.5 (1.3)	5.6
E	5.3 (0.6)	5.6 (1.0)	5.5
R	5.2 (0.9)	5.6 (0.8)	5.4
PF	5.5 (1.1)	5.1 (1.6)	5.2
RP	4.4	5.2 (1.5)	5.0 (1.0)
D	4.5 (2.1)	3.8 (1.9)	3.9
Unweighted Means	5.6	5.5	5.5

Training in AIF Use. The amount of training received in AIF use is summarized in Table 23. Except for demonstration, it appears that the SIs received at least moderate amounts of training in the use of each feature. The analysis of covariance revealed a significant main effect of AIF, $F(8,208) = 21.98$, $p < .001$. However, neither the main effect of training unit nor the AIF by training unit interaction was significant, $F(1,25) = 2.49$, $p > .05$ and $F(8,208) = 1.62$, $p > .05$, respectively. The Tukey HSD test revealed that, except for record/playback and demonstration, the amount of training received in AIF use was fairly consistent.

Table 23. CH-3, HH-53 Flight Simulators: Mean Ratings (and Standard Deviations) of the Amount of Training Received in AIF Use

Feature	RTU	CTU	Combined
M	4.7 (2.2)	5.5 (1.9)	5.2
TSF	4.5 (1.2)	5.4 (1.4)	5.0
E	3.9 (1.6)	5.4 (1.4)	4.8
R	4.1 (1.0)	5.0 (1.6)	4.6
PF	3.9 (1.4)	4.9 (1.7)	4.5
CKO	4.1 (1.8)	4.8 (1.8)	4.5
PAM	4.0 (1.5)	4.8 (1.7)	4.5
RP	2.1 (0.9)	4.5 (1.2)	3.5
D	1.5 (1.2)	1.8 (1.2)	1.7
Combined	3.6	4.7	4.3

Training value of AIFs. The training value ratings are summarized in Table 24. The ratings were very high, with most of the means in the 4.5 to 6.5 range (i.e., considerable to great). Only demonstration received a low mean rating. There was no significant overall difference between the RTU and CTU ratings, $T = 7$, $p > .05$, nor were there any significant RTU/CTU differences for particular features.

Table 24. CH-3, HH-53 Flight Simulators: Mean Ratings (and Standard Deviations) of the Training Value of AIFs

Feature	RTU	CTU	Combined
M	6.2 (1.4)	6.4 (1.1)	6.4
TSF	6.0 (1.2)	6.2 (0.9)	6.1
E	5.2 (1.5)	5.8 (1.0)	5.5
PAM	5.5 (1.4)	5.5 (1.4)	5.5
R	5.0 (1.3)	5.6 (1.3)	5.4
PF	5.0 (1.4)	5.4 (1.7)	5.2
CKO	5.1 (1.4)	4.8 (1.9)	4.9
RP	4.1 (1.7)	5.0 (1.8)	4.7
D	3.0 (2.3)	2.7 (1.7)	2.8
Unweighted Means	5.0	5.3	5.2

Potential Training Value of AIFs

A three-factor (ATD x AIF x Training Unit) repeated measures analysis of covariance (covariate = number of instructor-hours) was used to analyze the MAC SIs' potential training value ratings. The analysis revealed only two significant effects: a main effect of AIF, $F(15,2265) = 38.64$, $p < .001$, and an AIF by ATD interaction, $F(30,2265) = 3.00$, $p < .001$. The relevant data are summarized in Table 25.

Table 25. MAC Aircrew Training Devices: Mean Ratings of the Potential Training Value of AIFs

Feature	C-5A/C-141	C-130	CH-3/HH-53	Combined
M	5.7	6.2	6.2	5.9
E	5.6	5.9	6.0	5.7
R	5.6	5.6	5.6	5.6
TSF**	5.0	5.8	6.2	5.4
PF	5.2	5.4	5.2	5.3
CKO	4.9	5.6	5.1	5.1
AMI	4.6	5.3	5.5	4.9
PAM*	4.7	5.0	5.7	4.9
RP**	4.7	4.1	5.4	4.7
PRM	4.8	4.7	4.0	4.6
PMS	4.4	5.0	4.5	4.5
D	4.5	4.3	4.4	4.4
IPT	4.3	3.7	4.1	4.1
RB	4.1	4.0	3.2	3.9
HC	3.7	4.0	4.0	3.8
AAT	3.9	3.6	3.5	3.8
Combined	4.7	4.9	4.9	4.8

*$p < .05$.
**$p < .01$.

The main effect of AIF was analyzed by the Tukey HSD test, which was used to make pairwise comparisons among the combined mean ratings. The results of that test are shown in Table 25 by the placement of brackets around the means that did not differ significantly ($p < .01$). Thus, the features rated highest in potential training value were motion, environmental, reset, total system freeze, and partial freeze, whereas the lowest rated features were demonstration, instructor pilot tutorial, recorded briefing, hard copy, and automated adaptive training.

The AIF by ATD interaction was analyzed by the Dunn test, which was used to make pairwise comparisons among the three mean ratings for each feature. Those features for which there was at least one significant comparison are marked with asterisks. In each case, the CH-3/HH-53 SIs rated that feature significantly higher in potential training value than did other SIs. More specifically, for total system freeze and parameters monitoring, the CH-3/HH-53 means were significantly higher than those of the C-5A/C-141, whereas for record/playback, the CH-3/HH-53 mean was significantly higher than that of the C-130.

Interrelations Among the Variables

Table 26 shows the intercorrelations among the MAC SIs' ratings of each feature on each of the five questions. All the coefficients are positive and significant, $p < .001$, although they are somewhat lower than those obtained from the ATC data. Nevertheless, it can be generally stated that the more frequently a feature was used, the easier it was to use, the more training was received in its use, and the greater was its training and potential training value.

Table 26. MAC Aircrew Training Devices: Matrix of Intercorrelations Among Frequency of Use, Ease of Use, Training Received, Training Value, and Potential Training Value

	FREQUSE	EASEUSE	TRECD	TVALUE	PTVALUE
FREQUSE	1.00				
EASEUSE	.41	1.00			
TRECD	.43	.29	1.00		
TVALUE	.57	.36	.42	1.00	
PTVALUE	.41	.22	.37	.67	1.00

Note All correlations are significant, $p < .001$.

Table 27 summarizes the results of a stepwise multiple linear regression analysis in which the frequency of AIF use was predicted from a linear combination of the remaining variables. The table indicates that, together, the predictor variables accounted for 41 percent of the variance in the frequency-of-use ratings, the most important predictor being training value, followed, in order, by ease of use and training received. (The addition of potential training value did not significantly increase predictability). These results were similar to those obtained from the ATC data except that approximately 12 percent less variability was accounted for.

Table 27. MAC Aircrew Training Devices: Multiple Linear Regression of Frequency of AIF Use on Ease of Use, Training Received, Training Value, and Potential Training Value

Dependent Variable: Frequency of AIF Use

Multiple R:	.64
Multiple R-Square:	.41
Standard Error of Estimate:	1.52

Analysis of Variance:

	Sum of Squares	DF	Mean Square	F	p
Regression	2021.4041	3	673.8013	293.34	< .001
Residual	2937.8682	1279	2.2970		

Summary of Stepwise Regression:

Step No.	Variable	Multiple R	Multiple RSQ	Increase in RSQ	F-to-Enter
1	TVALUE	.57	.33	.33	622.06
2	EASEUSE	.61	.38	.05	98.86
3	TRECD	.64	.41	.03	70.09

Strategic Air Command

FB-111A Simulator Training Mission

The FB-111A mission lasts 3 to 5 hours, including approximately 1 to 2 hours of ground time for prebriefing and debriefing, and 2 to 3 hours of in-flight training. Both peacetime and Emergency War Order (EWO) mission

profiles are used. A typical RTU mission consists of various basic skills, such as power on/off, preflight, taxi, takeoff, departure, formation, air refueling, descent to low level, climb, penetration, bombing, and landing. A typical CTU mission includes formation, air refueling, low-level navigation and defensive tactics, emergency-procedure recovery to an unfamiliar airfield, tank rendezvous, weapons delivery, communication procedures, electronic countermeasures, and other tactics that comprise the EWO mission profile. Selected malfunctions are inserted throughout both RTU and CTU missions.

Frequency of AIF Use

The frequency-of-use ratings are summarized in Table 28. Most of the means are above 4.5 (i.e., _frequently_), which suggests that the frequency of AIF use was generally high. The analysis of covariance revealed a significant main effect of AIF, $F(11,649) = 129.73$, $p < .001$, and a significant AIF by training unit interaction, $F(11,649) = 4.01$, $p < .001$. The overall difference between the RTU and CTU ratings was not significant, $F < .001$.

The Tukey HSD test revealed that parameters and procedures monitoring received significantly higher ratings than did all other features, while record/playback, demonstration, and hard copy received significantly lower ratings than did all other features ($p < .01$). The Dunn test revealed only one significant RTU/CTU comparison: programmed mission scenarios were used more frequently by CTU SIs than by RTU SIs.

Ease of AIF Use

The ease-of-use ratings are summarized in Table 29. Ease of use was high, with most of the means in the 4.0 to 6.5 range (i.e. _moderate_ to _very easy_). There was no overall difference between the RTU and CTU ratings, $T = 26.5$, $p > .05$, nor were there any significant RTU/CTU differences for particular features.

Training in AIF Use

The amount of training received in AIF use is summarized in Table 30. Most of the means ranged from 3.5 to 5.5 (i.e., _moderate_ to _considerable_). The analysis of covariance revealed a significant main effect of AIF, $F(11,660) = 53.84$, $p < .001$; however, neither the main effect of Training Unit nor the AIF by Training Unit interaction was significant, $F(1,59) = 1.73$, $p > .05$ and $F(11,660) = 1.79$, $p > .05$, respectively.

The results of the Tukey HSD test were similar to those obtained from the frequency-of-use data. Parameters monitoring and procedures monitoring received significantly higher ratings than all other features, while record/playback, demonstration, and hard copy received the lowest ratings.

Table 28. FB-111A Operational Flight Trainer: Mean Ratings (and Standard Deviations) of the Frequency of AIF Use

Feature	RTU	CTU	Combined
PAM	6.8 (0.5)	6.6 (0.8)	6.7
PRM	6.8 (0.5)	6.6 (1.0)	6.6
M	5.8 (1.8)	5.8 (1.5)	5.8
E	5.7 (1.4)	5.8 (1.2)	5.7
CKO	4.9 (0.9)	5.5 (1.3)	5.4
PF	5.4 (1.1)	4.6 (1.6)	4.8
PMS**	3.6 (2.2)	5.3 (1.7)	4.8
R	4.5 (1.3)	4.8 (1.3)	4.8
TSF	4.0 (1.2)	4.4 (1.4)	4.3
RP	2.5 (1.2)	1.7 (0.8)	2.0
D	1.6 (0.8)	1.4 (0.6)	1.5
HC	1.4 (0.6)	1.3 (0.6)	1.3
Combined	4.4	4.5	4.5

**p < .01.

Table 29. FB-111A Operational Flight Trainer: Mean Ratings (and Standard Deviations) of the Ease of AIF Use

Feature	RTU	CTU	Combined
TSF	6.2 (1.0)	6.4 (0.8)	6.3
CKO	6.3 (0.8)	6.3 (0.9)	6.3
PF	6.1 (1.0)	6.2 (1.0)	6.2
M	5.8 (1.3)	6.2 (0.9)	6.1
E	5.5 (0.9)	5.8 (1.0)	5.7
R	5.4 (1.5)	5.7 (1.0)	5.6
PAM	4.9 (1.4)	4.5 (1.4)	4.6
PMS	4.3 (1.6)	4.3 (1.3)	4.3
PRM	4.8 (1.6)	4.1 (1.6)	4.3
RP	3.8 (1.4)	3.3 (1.4)	3.5
D	2.8 (1.5)	2.9 (1.1)	2.9
HC	2.4 (1.4)	2.7 (1.8)	2.6
Unweighted Means	4.9	4.9	4.9

Table 30. FB-111A Operational Flight Trainer: Mean Mean Ratings (and Standard Deviations) of the Amount of Training Received in AIF Use

Feature	RTU	CTU	Combined
PRM	4.9 (1.4)	5.6 (1.2)	5.5
PAM	4.9 (1.4)	5.5 (1.3)	5.4
M	4.4 (1.2)	4.8 (1.6)	4.6
E	3.9 (1.2)	4.8 (1.2)	4.5
CKO	4.1 (0.9)	4.5 (1.4)	4.4
PF	4.2 (1.3)	4.4 (1.6)	4.4
TSF	4.1 (1.1)	4.3 (1.4)	4.3
R	3.8 (1.3)	4.3 (1.3)	4.2
PMS	3.2 (1.6)	4.0 (1.8)	3.7
RP	2.9 (1.4)	2.2 (1.2)	2.4
D	2.4 (1.4)	2.2 (1.4)	2.2
HC	1.3 (0.6)	1.4 (0.7)	1.4
Combined	3.7	4.0	3.9

Training Value of AIFs

The training value ratings are summarized in Table 31. The ratings were very high, with most of the means in the 4.5 to 6.5 range (i.e., considerable to great). Although there were no significant RTU/CTU comparisons for particular features, the CTU SIs' ratings were significantly higher, overall, than those of the RTU SIs, $T = 11$, $p < .05$.

Table 31. FB-111A Operational Flight Trainer: Mean Ratings (and Standard Deviations) of the Training Value of AIFs

Feature	RTU	CTU	Combined
PRM	6.3 (1.0)	6.4 (0.9)	6.4
PAM	6.3 (1.0)	6.3 (1.0)	6.3
PF	6.2 (0.8)	5.9 (1.2)	6.0
TSF	5.5 (1.3)	5.9 (1.2)	5.8
E	5.3 (0.8)	5.6 (1.0)	5.5
M	5.5 (1.2)	5.2 (1.8)	5.3
CKO	4.9 (0.6)	5.4 (1.6)	5.2
R	4.9 (1.5)	5.2 (1.4)	5.1
PMS	4.3 (1.9)	5.0 (1.5)	4.9
RP	3.9 (1.3)	3.7 (1.6)	3.7
D	3.3 (1.6)	3.8 (1.7)	3.7
HC	2.0 (0.8)	2.9 (1.3)	2.7
Unweighted Means*	4.9	5.1	5.0

*$p < .05$.

Potential Training Value of AIFs

The potential training value ratings are summarized in Table 32. Like the training value ratings, these ratings were also very high, with most of

Table 32. FB-111A Operational Flight Trainer: Mean Ratings (and Standard Deviations) of the Potential Training Value of AIFs

Feature	RTU	CTU	Combined
PRM	6.7 (0.5)	6.8 (0.5)	6.8
PAM	6.6 (0.5)	6.5 (0.7)	6.6
PF	6.2 (1.1)	5.9 (1.2)	6.0
TSF	5.8 (1.1)	6.0 (1.0)	5.9
E	5.9 (0.8)	5.9 (1.0)	5.9
M	5.9 (1.2)	5.6 (1.7)	5.7
CKO	5.5 (1.3)	5.7 (1.4)	5.6
R	5.5 (1.0)	5.6 (1.1)	5.6
PMS	5.3 (1.5)	5.5 (1.4)	5.4
AMI	5.0 (2.0)	4.9 (1.5)	4.9
AAT	4.9 (1.8)	4.5 (1.7)	4.6
RP	5.2 (1.3)	4.4 (1.7)	4.6
D	4.9 (1.8)	4.4 (1.5)	4.5
IPT	4.4 (1.7)	4.3 (1.6)	4.3
HC	4.2 (1.9)	4.1 (1.6)	4.1
RB	3.7 (1.7)	3.8 (1.6)	3.7
Combined	5.4	5.2	5.3

the means in the 4.5 to 6.5 range (i.e., considerable to great). Even the lowest rated feature, recorded briefing, was still considered to have moderate potential training value. The analysis of covariance revealed only one significant effect, that of AIF, $F(15,885) = 25.40$, $p < .001$.

Interrelations Among the Variables

Table 33 shows the intercorrelations among the FB-111A SIs' ratings of each feature on each of the five questions. All of the coefficients are positive and significant, $p < .001$, as they were for the ATC and MAC data. Thus, the more frequently a feature was used, the easier it was to use, the more training was received in its use, and the greater its training and potential training value.

Table 33. FB-111A Operational Flight Trainer: Matrix of Intercorrelations Among Frequency of Use, Ease of Use, Training Received, Training Value, and Potential Training Value

	FREQUSE	EASEUSE	TRECD	TVALUE	PTVALUE
FREQUSE	1.00				
EASEUSE	.33	1.00			
TRECD	.53	.29	1.00		
TVALUE	.58	.32	.53	1.00	
PTVALUE	.50	.23	.44	.77	1.00

Note All correlations are significant, $p < .001$.

Table 34 summarizes the results of a stepwise multiple linear regression analysis in which the frequency of AIF use was predicted from a linear combination of the remaining variables. The table indicates that, together, the predictor variables accounted for 42 percent of the variance in the frequency-of-use ratings, the most important predictor being training value, followed, in order, by training received, ease of use, and potential training value (which contributed relatively little to the overall level of predictability). These results were similar to those obtained from ATC and from MAC.

Table 34. FB-111A Operational Flight Trainer: Multiple Linear Regression of Frequency of AIF Use on Ease of Use, Training Received, Training Value, and Potential Training Value

Dependent Variable: Frequency of AIF Use

Multiple R:	.65
Multiple R-Square:	.42
Standard Error of Estimate:	1.44

Analysis of Variance:

	Sum of Squares	DF	Mean Square	F	p
Regression	1012.0051	4	253.0013	121.75	< .001
Residual	1371.5435	660	2.0781		

Summary of Stepwise Regression:

Step No.	Variable	Multiple R	Multiple RSQ	Increase in RSQ	F-to-Enter
1	TVALUE	.58	.34	.34	337.56
2	TRECD	.64	.41	.07	77.75
3	EASEUSE	.65	.42	.01	15.04
4	PTVALUE	.65	.42	.00	5.01

IV. DISCUSSION

For purposes of discussion, the 16 AIFs surveyed in Phase II can be organized into four categories.

Briefing AIFs are designed for briefing the student and SI prior to or during a training mission. The purpose is to establish a learning set and to increase learning readiness. These features include

1. Instructor pilot training.
2. Recorded briefing.
3. Demonstration.

Training Management AIFs include various features designed to control the structure and sequencing of tasks within a training mission. These features include

1. Total system freeze.
2. Reset.
3. Automated adaptive training.
4. Programmed mission scenarios.

Variation of Task Difficulty/Fidelity AIFs permit the SI to control the difficulty of simulated flight through variations in ATD fidelity, configuration, or task load demands. These features include

1. Automated malfunction insertion.
2. Partial freeze.
3. Crash/kill override.
4. Environmental.
5. Motion.

Monitor and Feedback AIFs permit the SI to monitor student performance and provide the student with performance feedback. These features include

1. Parameters monitoring.
2. Procedures monitoring.
3. Record/playback.
4. Hard copy.

Air Training Command

Briefing AIFs. None of these features were available on the T-50 and T-51 ATDs. While several SIs considered these features to have significant potential training value in terms of time and manpower savings, most SIs believed that automated briefings would not permit sufficient flexibility. For example, during a "dual" mission, it would simply be easier and more appropriate for SIs to fly demonstrations themselves.

Training management AIFs. Total system freeze and reset were among the most often used, easily used, and highly valued AIFs. These features, which are typically used in succession, permit SIs to temporarily suspend the mission in order to offer instruction and then to rapidly re-initialize the ATD to a particular configuration. Automated adaptive training and programmed mission scenarios were unavailable. Since most SIs preferred to manage training themselves, neither feature received particularly high potential training value ratings.

Variation of task difficulty/fidelity AIFs. Environmental and motion were among the most frequently used and highly valued features. Environmental was especially important for T-37 trainees since it offered them their only experience with instrument flying. Partial freeze was used significantly more often by T-51 SIs. This did not reflect a difference in training value, but rather, was due to a difference in accessibility. Partial freeze could only be activated from the T-50 remote console, whereas T-51 SIs could freeze altitude, position, and heading at the cockpit control panel.

Automated malfunction insertion was used infrequently by both groups. Most instructors preferred to insert malfunctions manually, because this was easier and permitted greater training flexibility. Crash override received only moderately frequent use, but it was an important feature since crashing can cause damage to the terrain model board probe. Otherwise crash override was considered to be a convenient means of avoiding a reset following a crash.

Monitor and feedback AIFs. Of the four monitor feedback features, only record/playback was available on the T-50 and T-51 ATDs. It was used with moderate regularity and was rated relatively high in training value. Parameters monitoring, procedures monitoring, and hard copy were considered to have moderate potential training value; one T-50 SI noted that hard copy might be especially useful for instrument training.

Differences between T-50 and T-51 SIs' ratings. Although there was a significant overall difference between the T-50 and T-51 SIs' frequency-of use-ratings, the significant AIF by ATD interaction suggests that this difference was mostly due to the greater use of partial freeze by T-51 SIs. It is not clear, however, why T-51 SIs also reported receiving more training in AIF use.

Military Airlift Command

Briefing AIFs. Most MAC SIs felt that instructor pilot tutorial and recorded briefing would not enhance simulator training. "Hands-on" training was considered to be superior to instructor pilot tutorial, and "face-to-face" briefings, which afford opportunity for trainees' questions, were preferred over recorded briefings.

Demonstration, which was available on the C-130 and CH-3 ATDs (it had been disabled on the HH-53 ATD), received relatively low ratings. Demonstrations were difficult and time-consuming to use, and the available examples were not sufficiently representative of the mission profiles. C-5A and C-141 SIs felt that demonstrations would probably be unnecessary since "transports do not do maneuvers," and crew coordination, which is of great importance for a successful mission, cannot be "demonstrated."

Training management AIFs. On the C-5A and C-141 ATDs, total system freeze was generally used only during emergencies or following serious errors. At the remaining ATD sites, it was regularly used to correct student procedures and to point out errors. Reset was frequently used by all MAC SIs.

Automated adaptive training was unavailable, and it was rated the lowest of all features in potential training value. One C-5A SI summed up the consensus opinion: "Computers don't know why a student is doing well and might increase complexity before the student is ready." Programmed mission scenarios were available on the C-130 ATD, but they were used the least of all AIFs. Apparently, the available scenarios did not match the mission requirements. Most MAC SIs believed that programmed mission scenarios could be valuable, but not if training flexibility was sacrificed.

Variation of task difficulty/fidelity AIFs. Motion and environmental were among the most frequently used, easily used, and valuable AIFs. Nevertheless, a few C-5A/C-141 and CH-3/HH-53 SIs noted deficiencies in reliability and fidelity. Partial freeze was used with moderate regularity in various situations. On the C-5A/C-141 ATDs, the SIs frequently used position freeze (rather than total system freeze) in order to point out student problems. Several C-130 SIs reported using position and altitude freeze in order to reduce student task load demands. CH-3 SIs used partial

freeze to prevent the simulator from "hitting" obstacles and used it during hover checks.

Automated malfunction insertion was available on the C-130 ATD, where it was used moderately often by the RTU SIs but very rarely by the CTU SIs. Apparently, the available malfunctions did not conform to the CTU mission profile. Although automated malfunction insertion was rated relatively high in potential training value, many SIs expressed the opinion that manual insertion was preferable.

Crash override was frequently used and highly valued at each ATD site. On the C-5A/C-141 and CH-3 ATDs, crash override is normally kept in the override position in order to avoid damage to the simulator. C-130 SIs used crash override during "non-visual" missions and during stall training.

Monitor and Feedback AIFs. Parameters and procedures monitoring were only occasionally used by C-130 SIs, many of whom believed it was easier to look at the instruments directly. Several CH-3/HH-53 SIs noted that their existing monitoring capability was not sensitive enough to measure the rapid changes in parameter values that occur during their mission. Several C-5A/C-141 SIs believed that it would be easier to monitor parameters and procedures "over-the-shoulder," while others considered these features to have significant potential value since "we miss a lot now."

Record/playback was among the lowest rated features on the C-130 ATD. It was considered time-consuming and relatively difficult to use. On the CH3/HH-53 ATDs, record/playback was also seldom used, but it was rated much higher in training value, probably because it was easier to use. There was considerable disagreement among the C-5A/C-141 SIs as to the potential training value of record/playback.

Hard copy was seldom used by C-130 SIs. Several instructors referred to it as "unreliable" and "time-consuming." Hard copy was generally considered to have only moderate potential training value; however, a few C-5A/C-141 SIs believed it would be useful for ground track recording and "accident" investigation.

Differences between MAC RTU and CTU SIs' ratings. The RTU and CTU mission profiles for each ATD were similar. It is not surprising, then, that there were relatively few significant differences between the RTU and CTU SIs' mean ratings. The only significant overall difference occurred in the CH-3/HH-53 data; the CTU SIs reported significantly greater use of AIFs than did the RTU SIs. The reason for this difference was not immediately apparent, but it is feasible that the greater complexity of the CH-3/HH-53 CTU mission required more frequent AIF use.

Strategic Air Command

Briefing AIFs. Instructor pilot tutorial and recorded briefing were rated as having only moderate potential training value. Most FB-111A SIs believed that "hands-on" and "face-to-face" instruction would be preferable. The demonstration feature was rarely used. It was sometimes inoperable, and the available demonstrations did not closely conform to the FB-111A mission profile. Nevertheless, some SIs believed that the

demonstration feature might be useful for defensive maneuvers and instrument training.

Training management AIFs. The FB-111A SIs used total system freeze and reset with considerable regularity, although the level of use was somewhat less than it was at most of the other ATD sites. Many FB-111A SIs apparently preferred to use position freeze in order to point out student errors.

Automated adaptive training was unavailable and was rated relatively low in potential training value. Programmed mission scenarios, particularly the ECM scenarios, were used moderately often. However, many SIs commented on the need for manual override. Since the CTU mission profile placed greater emphasis on ECM, it seems probable that the significant difference between the RTU and CTU SIs' use of programmed mission scenarios reflected this emphasis.

Variation of task difficulty/fidelity AIFs. As was the case at the other ATD sites, motion and environmental were among the highest rated features on each of the five questions. There were several criticisms of these features, however. Motion was not always operational, and environmental, which was frequently used to vary navigational difficulty, was less appropriate for other purposes.

Partial freeze (i.e., ground position freeze) was frequently used instead of total system freeze (i.e., problem freeze) in order to temporarily suspend the mission and discuss a problem. Crash/kill override was frequently used and was considered to have high training value. The FB-111A SIs, like those at most of the other ATD sites, typically kept this feature in the override mode in order to save time and to protect the simulator from damage.

At the time the survey was conducted, automated malfunction insertion had only recently been implemented on the SATCOM instructor terminal. Automated malfunction insertion was rated as having considerable potential training value because it would ease the SI's workload. Nevertheless, like most of the SIs surveyed, the FB-111A SIs generally believed that manual insertion would permit greater training flexibility.

Monitor and feedback AIFs. Parameters and procedures monitoring were rated highest of all features on frequency of use and training value. The comparable ratings were lower from the other ATD sites at which these features were available. These differences can be accounted for by pointing out that on the FB-111A ATD, parameters and procedures monitoring is done at a remote instructor console. Thus, it is the FB-111A SI's primary means of monitoring the simulated aircraft. In contrast, at the other ATD sites, the instructor console was located "in the box," which permitted SIs to monitor students' performance "over-the-shoulder."

Both record/playback and hard copy were available but were rarely used. Neither feature was always operational. Moreover, record/playback was limited to visual playback only, thus making it unsuitable for student-navigator feedback. Hard copy, which was assigned the lowest ratings of all available features, was said to yield output that was difficult to interpret.

Differences between FB-111A RTU and CTU SIs' ratings. There were very few significant differences between the RTU and CTU SIs' mean ratings. Of all the available features, only one, programmed mission scenarios, was used more frequently by one group (CTU SIs) than by the other (RTU SIs). This finding was discussed previously. The only other significant difference was in the training value ratings. CTU SIs assigned higher training value ratings, overall, than did RTU SIs. The reason for this difference was not apparent. In any case, the magnitude of this effect was rather small.

Predicting the Frequency of AIF Use

The stepwise multiple linear regression analyses of the three sets of data (see Tables 11, 27, 34) indicated that at least 40 percent, and as much as 53 percent, of the variability in the frequency-of-use ratings could be explained by the remaining variables. Training value, alone, accounted for over 30 percent in each data set.

What can be concluded from these facts? Unfortunately, correlational findings do not logically imply causality. Instead, they merely reflect the likely presence of a relationship between variables. In this case, however, it seems reasonable to assume that particular AIFs were used more frequently because they had greater training value. Indeed, assuming that the training value of an AIF did not affect its use is clearly implausible. The remaining variables, i.e., ease of use, amount of training received, and potential training value, together accounted for only 10 percent additional variability (averaged over the three commands) in the frequency-of-use ratings. It seems likely that these variables also influenced the frequency of AIF use but to a much lesser extent than did training value.

Comparisons Between Phase I and Phase II

The most striking difference between the Phase I and Phase II results was in the overall magnitude of the ratings. The ATC, MAC, and SAC SIs consistently rated the features higher on all variables than did the TAC SIs. This suggests that TAC SIs used AIFs less often, found them more difficult to use, received less training in their use, and considered AIFs to be less important for training. As described in Section I of this report, these low ratings were due in part to various problems with the AIFs, such as hardware and software unreliability, time-consuming implementation, functional limitations, and design deficiencies. ATC, MAC, and SAC SIs reported these same problems, but their level of AIF use remained high. Why was this so?

One explanation involves the training received by the SIs. The TAC SIs reported that they received considerably less training in AIF use than did the other MAJCOM SIs. Moreover, the word "informal" was chosen more often by TAC SIs when describing the kind of training they did receive. In contrast, ATC, MAC, and SAC SIs chose "formal" more often when describing their training. These facts suggest that TAC's SI training program is less extensive and less structured than are those of the other MAJCOMs.

There were some similarities in the Phase I and Phase II results. The relative ratings of particular AIFs were fairly consistent across all ATDs. That is, those features rated highest (lowest) by one group of SIs

also tended to be rated highest (lowest) by the other groups. This suggests that the overall pattern of AIF use is similar across the MAJCOMs. One notable exception was motion. It was consistently among the highest rated features at ATC, MAC, and SAC ATD sites; however, it was rated lowest of all features in potential training value by the TAC SIs. This difference was probably due to the fact that most ATD motion systems are not capable of high fidelity simulation of fighter aircraft movement.

V. RECOMMENDATIONS AND CONCLUSION

At the end of Phase I, it was recommended that certain AIFs need to be made more reliable and user friendly before their training effectiveness can be ascertained. It was also recommended that a formal intensive training program be established in order to teach TAC SIs how to use AIFs more effectively. These recommendations apply to Phase II as well, for it is clear that most SIs, regardless of command, have not yet fully explored the existing instructional capabilities of ATDs. The principles of effective AIF use still need to be specified, however. Such principles will not be derived from surveys but, rather, from empirical investigations.

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APPENDIX

INSTRUCTIONAL FEATURES QUESTIONNAIRE

ADVANCED INSTRUCTIONAL FEATURES - IP SURVEY

Name______________________________Rank_________Squadron________Date____________________

FLYING EXPERIENCE:

Aircraft	Total Hours	IP Hours
____________	________	________

SIMULATOR EXPERIENCE:

Simulator	Total Hours	IP Hours
____________	________	________

BRIEFLY DESCRIBE A "TYPICAL" TRAINING SESSION ON THIS SIMULATOR:

GENERAL COMMENTS AND/OR RECOMMENDATIONS:

Please familiarize yourself with these instructional features and their definitions: For each feature, insert 1 (available) or 0 (unavailable):

(1/0)

____ Instructor Pilot Tutorial - provides the IP with self-paced programmed instruction in the capabilities and use of the flight simulator.

____ Reset - permits instructor to "return" the simulated aircraft to a stored set of conditions and parameters.

____ Total System Freeze - permits instructor to interrupt and suspend simulated flight by freezing all system parameters.

____ Recorded Briefing - permits instructor to provide student with information about a structured training session through audio/visual media presentation.

____ Demonstration - permits instructor to demonstrate aircraft maneuver(s) by prerecording and subsequently playing back a standardized segment of simulated flight.

____ Record/Playback - permits instructor to record and subsequently playback all events that occurred during a segment of simulated flight.

____ Environmental - permits instructor to vary environmental conditions such as wind direction and velocity, turbulence, temperature, visibility, etc.

____ Automated Malfunction Insertion - permits instructor to pre-program a sequence of aircraft component malfunctions and/or emergency conditions.

____ Partial Freeze - permits instructor to freeze various flight parameters or parameter combinations such as altitude, heading, position, attitude, flight system, etc.

____ Crash and/or Kill Override - permits instructor to allow simulated flight to continue without interruption following a "crash" or "kill."

____ Motion - permits instructor to vary platform motion system cues such as roll, pitch, lateral, vertical, etc.

____ Hard Copy - provides a record of alphanumeric and/or graphic performance data from the automated performance measurement system for debriefing purposes.

____ Automated Adaptive Training - computer-controlled variations in task difficulty, complexity, and sequence based on pilot's performance.

____ Programmed Mission Scenarios - computer-controlled standardized training sessions based on pre-programmed event sequences.

____ Procedures Monitoring - permits instructor to monitor discrete actions performed by the student in accordance with a procedurally defined checklist.

____ Parameters Monitoring - permits instructor to monitor various instrument readings, control settings, aircraft states, or navigational profiles.

1. How often have you used each instructional feature? (Check the appropriate space.)

Feature	/never	/rarely	/occasionally/	/monerately/ often	/frequently/	very frequently/	most often
	1	2	3	4	5	6	7

Instructor Pilot Tutorial — 1 2 3 4 5 6 7

Comments:

Reset — 1 2 3 4 5 6 7

Comments:

Total System Freeze — 1 2 3 4 5 6 7

Comments:

Recorded Briefing — 1 2 3 4 5 6 7

Comments:

Demonstration — 1 2 3 4 5 6 7

Comments:

Record/Playback — 1 2 3 4 5 6 7

Comments:

Environmental — 1 2 3 4 5 6 7

Comments:

Automated Malfunction Insertion — 1 2 3 4 5 6 7

Comments:

Partial Freeze — 1 2 3 4 5 6 7

Comments:

Crash and/or Kill Override — 1 2 3 4 5 6 7

Comments:

Motion — 1 2 3 4 5 6 7

Comments:

Hard Copy — 1 2 3 4 5 6 7

Comments:

Automated Adaptive Training — 1 2 3 4 5 6 7

Comments:

Programmed Mission Scenarios — 1 2 3 4 5 6 7

Comments:

Procedures Monitoring — 1 2 3 4 5 6 7

Comments:

Parameters Monitoring — 1 2 3 4 5 6 7

Comments:

2. How easy is it to use each instructional feature? (Check the appropriate space.)

Feature	?	most difficult	very difficult	difficult	moderate	easy	very easy	easiest
	0	1	2	3	4	5	6	7
Instructor Pilot Tutorial								
Reset								
Total System Freeze								
Recorded Briefing								
Demonstration								
Record/Playback								
Environmental								
Automated Malfunction Insertion								
Partial Freeze								
Crash and/or Kill Override								
Motion								
Hard Copy								
Automated Adaptive Training								
Programmed Mission Scenarios								
Procedures Monitoring								
Parameters Monitoring								

Each feature is followed by: Comments:

3. How much training did you receive in the use of each instructional feature? (Check the appropriate space. Please comment as to whether the training was formal or informal.)

Feature / none /minimal/ some /moderate/considerable/great/greatest/

Instructor Pilot Tutorial — 1 2 3 4 5 6 7
Comments:

Reset — 1 2 3 4 5 6 7
Comments:

Total System Freeze — 1 2 3 4 5 6 7
Comments:

Recorded Briefing — 1 2 3 4 5 6 7
Comments:

Demonstration — 1 2 3 4 5 6 7
Comments:

Record/Playback — 1 2 3 4 5 6 7
Comments:

Environmental — 1 2 3 4 5 6 7
Comments:

Automated Malfunction Insertion — 1 2 3 4 5 6 7
Comments:

Partial Freeze — 1 2 3 4 5 6 7
Comments:

Crash and/or Kill Override — 1 2 3 4 5 6 7
Comments:

Motion — 1 2 3 4 5 6 7
Comments:

Hard Copy — 1 2 3 4 5 6 7
Comments:

Automated Adaptive Training — 1 2 3 4 5 6 7
Comments:

Programmed Mission Scenarios — 1 2 3 4 5 6 7
Comments:

Procedures Monitoring — 1 2 3 4 5 6 7
Comments:

Parameters Monitoring — 1 2 3 4 5 6 7
Comments:

4. Rate the training value of each instructional feature. (Check the appropriate space.)

Feature	/ ? / none /minimal/ some /moderate/considerable/great/greatest/
Instructor Pilot Tutorial	0 1 2 3 4 5 6 7
Comments:	
Reset	0 1 2 3 4 5 6 7
Comments:	
Total System Freeze	0 1 2 3 4 5 6 7
Comments:	
Recorded Briefing	0 1 2 3 4 5 6 7
Comments:	
Demonstration	0 1 2 3 4 5 6 7
Comments:	
Record/Playback	0 1 2 3 4 5 6 7
Comments:	
Environmental	0 1 2 3 4 5 6 7
Comments:	
Automated Malfunction Insertion	0 1 2 3 4 5 6 7
Comments:	
Partial Freeze	0 1 2 3 4 5 6 7
Comments:	
Crash and/or Kill Override	0 1 2 3 4 5 6 7
Comments:	
Motion	0 1 2 3 4 5 6 7
Comments:	
Hard Copy	0 1 2 3 4 5 6 7
Comments:	
Automated Adaptive Training	0 1 2 3 4 5 6 7
Comments:	
Programmed Mission Scenarios	0 1 2 3 4 5 6 7
Comments:	
Procedures Monitoring	0 1 2 3 4 5 6 7
Comments:	
Parameters Monitoring	0 1 2 3 4 5 6 7
Comments:	

6. Rate the potential training value of each instructional feature, including those you are not familiar with. Assume that you have had no experience using any of the features and that all of them are equally easy to u Therefore, base your ratings on the feature definitions alone. (Check the appropriate space.)

Feature	none /minimal/ some /moderate/considerable/great/greatest/
Instructor Pilot Tutorial	1 2 3 4 5 6 7
Comments:	
Reset	1 2 3 4 5 6 7
Comments:	
Total System Freeze	1 2 3 4 5 6 7
Comments:	
Recorded Briefing	1 2 3 4 5 6 7
Comments:	
Demonstration	1 2 3 4 5 6 7
Comments:	
Record/Playback	1 2 3 4 5 6 7
Comments:	
Environmental	1 2 3 4 5 6 7
Comments:	
Automated Malfunction Insertion	1 2 3 4 5 6 7
Comments:	
Partial Freeze	1 2 3 4 5 6 7
Comments:	
Crash and/or Kill Override	1 2 3 4 5 6 7
Comments:	
Motion	1 2 3 4 5 6 7
Comments:	
Hard Copy	1 2 3 4 5 6 7
Comments:	
Automated Adaptive Training	1 2 3 4 5 6 7
Comments:	
Programmed Mission Scenarios	1 2 3 4 5 6 7
Comments:	
Procedures Monitoring	1 2 3 4 5 6 7
Comments:	
Parameters Monitoring	1 2 3 4 5 6 7
Comments:	

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